REMARKS

Responsive to the aforementioned office letter, and first addressing the issue of the drawings, the applicant notes there are no objections to the formal drawings raised by the Official Draftsperson or the Examiner.

At the outset, with respect to the merits of the claims, applicant wishes to advise that he had filed a preliminary Amendment A (photocopy attached) and which was mailed from the office of the applicant's undersigned attorney on January 16, 1997. Indeed, that Amendment A was mailed to the U.S. Patent and Trademark Office on the same date as the appointment of a new attorney and revocation of a previous power of attorney. Nevertheless, the office action which is dated March 18, 1997 deals only with the claims as originally filed with the application and not the new set of claims. More specifically, that office action does not deal at all with new Claims 12-20 as set forth in applicant's Amendment A. Accordingly, it is believed that a new office action should be issued. Indeed, in any case, it is urged that any next office action should not be made a final rejection since it had not dealt with at least Claims 12-20 of applicant's Amendment A.

In this present amendment, the applicant has further amended certain of the claims. However, the applicant has treated these claims as though the Amendment A was actually entered in the file of the application. Accordingly, any underlining which is presented does not include underlining under portions which have previously be added in applicant's Amendment A.

The Examiner rejects each of the claims in the application on the basis of U.S. patent No. 4,695,758 to Nishida, et al taken alone and in combination with the Riley patent No. 1,499,594. The applicant has carefully considered this rejection and believes that there is subject matter which patentably distinguishes over Nishida taken alone or in combination with any of the other references made of record.

Prior to discussing the claims and the impact of the prior art on these claims, it is believed that a brief discussion of the nature of the present invention and that of the prior art references would be most helpful.

Although not immediately apparent from the patent itself, Nishida, et al are actually dealing with a different type of product than the spark plug taught and claimed in the instant application. The title of the Nishida et al patent alone reveals that this patent is dealing with a small-sized spark plug which uses a spark gap traversing an axis parallel to the center electrode. On the other hand, the applicant is addressing spark plugs primarily used with high performance vehicles and, particularly, high performance racing vehicles. The whole purpose of the structure in the Nishida, et al. patent was to provide a spark plug having a size smaller than the conventional spark plus of the type used in conventional automotive vehicles. The problems encountered by Nishida and the solutions therefor are entirely different then the problems encountered by the applicant herein.

The applicant of the present invention is not necessarily concerned with size as such. Weight is somewhat of an important

consideration, although the weight of the spark plus is usually relatively minor compared to the overall weight of the engine in a high performance racing vehicle. The applicant was concerned with designing a spark plug which would quickly and very efficiently ignite the gas surrounding that spark plug so as to obtain the maximum torque in each stroke. In addition, applicant had to be certain, in an effort to insure a smooth ignition of the fuel, that there was no substantial overheating of the spark plug. Further, the applicant sought to avoid ignition at the outer edge of the disk on the end of the center electrode in a region that is near the outer portion of the spark plug body generally, and also sought to avoid ignition in the region of the central axis of the spark plug, both of which would have resulted in inefficiency. It is urged that these problems were not addressed by and, in fact, were not even suggested by Nishida, et al.

Another one of the important problems in the use of a spark plug designed for high performance racing vehicles is the fact that oil must be kept away from the tip of the plug. In addition, one of the problems which is typically encountered at high RPM's, which is not usually a problem in conventional vehicles, is the fact that the spark becomes unstable.

In the case of the present invention, the spark is held between the disk at the end of the center electrode and the disk forming part of the opposite electrode.

It is admitted that Nishida does teach of a spark plug which has a disk-shaped element at an end of the inner electrode. This structure is clearly shown on the abstract page as well as in

Figures 2A and 2B of Nishida, et al. It is also noted that a spark can travel in the gap between elements 2A and 1A in Nishida, et al. However, beyond this, there is marked distinction between the device of the instant application and that plug shown by Nishida, et al with respect to the claims. First of all, Nishida, et al utilizes a spark which literally travels along the peripheral face of the insulator 3, as even described in Nishida, et al. This has been found to be inefficient particularly for high performance type engine operation. In addition, the applicant desires to have a spark anywhere within the desired region encompassed by the disk-shaped element.

Nishida, et al utilizes an annular lip to keep the spark focused on the insulator. This can be readily observed since the lip at the section 1a is actually bent close to the surface of the insulator, even though there is admittedly a slight space between the projection at this point 1a and the insulator. Nevertheless, all sparks must travel within this narrow gap. To the contrary, the applicant does not wish to limit the sparking only in that very limited gap size. Contrariwise, the applicant allows for the spark to occur essentially anywhere in that spark zone between the two electrodes. This obviously cannot be the case in Nishida, et al.

Applicant specifically does not wish for a spark to travel along the face of the insulator, such as the insulator 3 in Nishida, et al. As a result of this activity in Nishida, et al, the Nishida, et al spark plug must necessarily run hot. In addition, in Nishida, et al and due to the fact that the spark travels along the face of the insulator, the spark effectively

crawls in this area and there is not a true jump across the gap. Thus, Nishida, et al would not be at all efficient for high performance engines or racing engines and, indeed, is not efficient for conventional vehicles. Specifically, Nishida, et al would not provide a spark plug that would be stable at higher RPM's.

A simple reading of the patent to Nishida, et al will reveal that Nishida, et al are only concerned with creating a creepage discharge. Indeed, attention is invited to column 3, line 6-19. In like manner, Nishida, et al refer to the channeling phenomena. This channeling phenomena is due to the passage of the spark along the surface of the insulator.

The device in Nishida, et al is of doubtful effectiveness if it would operate at all. Due to the very large gaps size, that is, the gap between the elements 1a and 2a in Figure 2A, for example, it would appear as though the spark would literally travel from the central electrode and through the insulator directly to the side of the insulator. Thus, a spark could very easily exit the insulator at the point where the reference numeral 3 is shown in Figure 2A in Nishida, et al. This arrangement is not desirable and, indeed, one which must be avoided by the applicant herein.

Although the spark plugs of the applicant are designed for high performance vehicles, they are nevertheless effective for general automotive use. In accordance with the spark plugs of the invention, the applicant has eliminated any creepage voltage. In this way, the insulator is cooler than the disk in applicant's device. Moreover, when examining Figure 2 of applicant's device, it can be seen that there is a large area between the disk and the

end of the outer electrode. This will allow for fuel to be available in the area in which the spark travels in applicant's plug. As a result, there will be little or no unburned fuel and, hence, no carbon deposit. Contrariwise, unburned fuel and carbon deposit will almost necessarily result in the device of the type taught in the Nishida, et al patent.

One of the problems with Nishida, et al is that with the unburned fuel and carbon deposits, a catalytic converter in a vehicle will immediately become fouled. The spark plug of applicant's invention does not suffer this limitation and is therefore widely and highly effective for general automotive use.

When the spark travels between the outer electrode and the disk, the disk will become hot relative to the other parts of the spark plug. This will cause a transference of heat to the fuel but not at a temperature sufficient to cause a preignition of the fuel. Rather, when the spark is generated, the fuel will burn in a more stable manner and quite rapidly. The fact that the disk transfers heat to the fuel causes an excitation of the molecules and the fuel will actually start expanding and become more volatile. Thus, when the spark is initiated, the fuel burns rapidly and quite efficiently. As a result, it can be seen that the device in the instant application is a marked improvement over Nishida, et al.

These features distinguishing the spark plug of the instant application over Nishida, et al have been brought out in each of the claims. Each of the claims in this application have been amended to recite that the spark can pass between the two electrodes at any point in the region of the 360° angular sparking

zone. In addition, the claims recite that this spark can pass between the inner and the outer electrode so that the points of ignition can continuously change. The disk-shaped element is recited as having a peripheral size which is almost equal to the peripheral size of the outer electrode end face. In accordance with this construction, a spark can occur close to the inner electrode or somewhat distal to the inner electrode and, moreover, it can occur at any point in the entire circumference of the disk-shaped element. This does not occur in Nishida, et al in which the spark only traverses the very thin gap. Admittedly, gap may be long but there only is a relatively thin contact area for the spark. Consequently, Nishida, et al represents an entirely different structure.

The applicant has further added new Claims 21 and 22 which are respectively dependent upon Claim 15. These Claims 21 and 22 call for the fact that the insulator is tapered inwardly from a point commencing axially beyond the end face of the outer electrode which is distal to the disk-shaped element, and is tapered between and from the end face of the outer electrode to the disk-shaped element. Thus, it is urged that this construction clearly is not shown in Nishida, et al. Admittedly, the insulator may be tapered. However, it is not tapered from a point well beyond the region between the areas defined by the gap 1a and 2a in Nishida, et al. Consequently, it is believed that Claims 21 and 22 distinguish over the prior art and allowance therefor is respectfully solicited.

Claim 19 already incorporates those limitations in Claims 21 and 22 by virtue of this amendment. Consequently, even if Claims

1-18 were not deemed to be allowable, it is urged that Claims 19 and 20 do contain allowable subject matter.

In view of the foregoing, favorable reconsideration and allowance is respectfully solicited.

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Respectfully submitted,

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